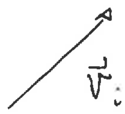
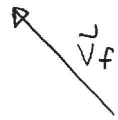
Phys 131

2016 Supp Ex 18

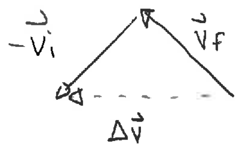
a) before



after

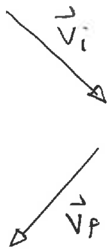


$\Delta\vec{v} = \vec{v}_f - \vec{v}_i =$

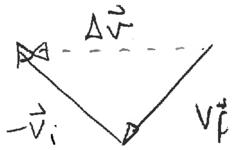


$\vec{a}$ is in same direction as $\Delta\vec{v}$ so $\vec{a}$ is $\leftarrow$

b)



$\Delta\vec{v} =$

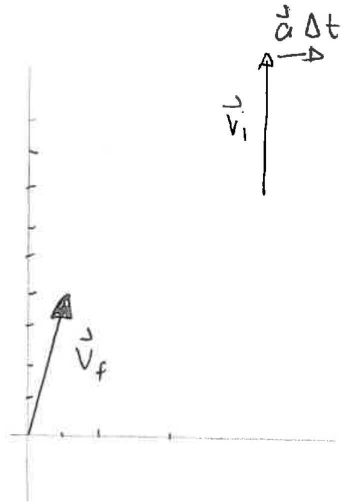


Again $\vec{a}$ is $\leftarrow$

Phys 131

2016 Supp Ex 20

a) $\vec{v}_f = \vec{v}_i + \vec{a}\,\Delta t$



$\vec{v}_i = 4\hat{j}$

$\vec{a} = 2\hat{i}$

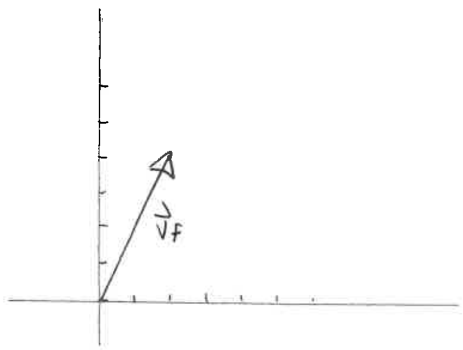
$\vec{v}_i + \vec{a}\,\Delta t = 4\hat{j} + 0.5 \times 2\hat{i}$

$= 4\hat{j} + \hat{i}$

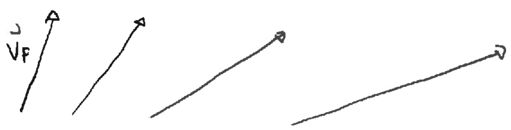
b) $\vec{v}_f = \vec{v}_i + \vec{a}\,\Delta t$

$\vec{v}_i = 4\hat{j}$ $\quad \vec{a} = 2\hat{i}$

$\vec{v}_f = \vec{v}_i + \vec{a}\,\Delta t = 4\hat{j} + 2\hat{i}$



c) we see that the horizontal component of $\vec{v}_f$ constantly increases. The vertical component stays constant



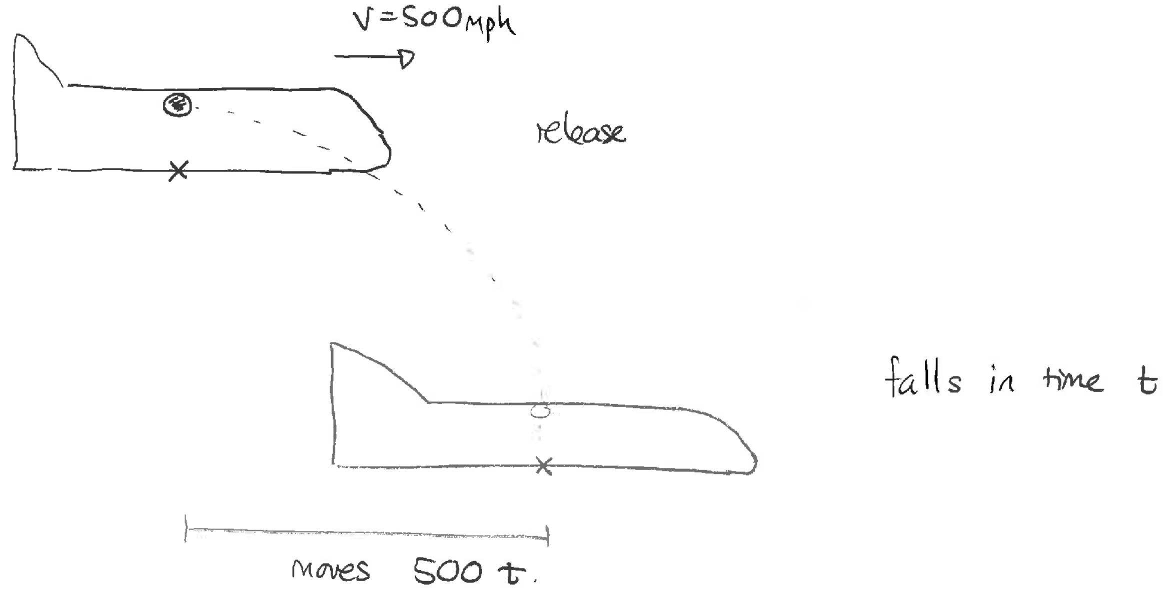
Neither of these represent case i) or ii). Case iii has $\vec{v}\rightarrow$ at end but it must have a vertical component

So iv) is the only possibility

Knight Ch 4

Conc Q 9

The ball will follow a curved trajectory but the horizontal component of its velocity will remain constant. This will be the same as the velocity of the plane



So the ball will hit x

CQ15, P 45

Knight Ch 4

Conc Q 13

a) The angle covered in 1s by any portion of the wheel is the same as that covered in 1s by any other portion.

So the angular velocities are all the same. Thus $\omega_1 = \omega_2 = \omega_3$

b) 3 covers a larger distance than 1,2 every second. So

$V_3 > V_1 = V_2$

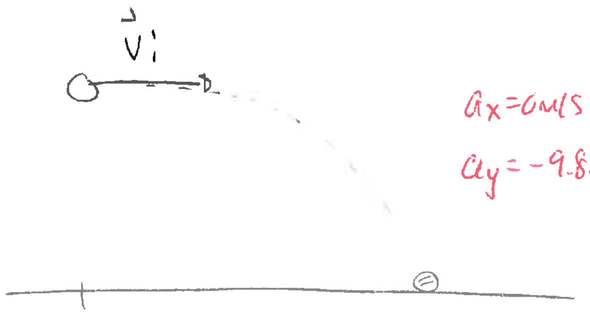
Also $V = \omega r \Rightarrow V_i = \omega_i \, r_i$

same larger for 3

Knight Ch 4

3ed ~~Prob 14~~

4ed Prob 13



$a_x = 0\,m/s$

$a_y = -9.8\,m/s^2$

$t_i = 0\,s$	$t_f =$
$x_i = 0\,m$	$x_f =$
$y_i = 100\,m$	$y_f = 0\,m$
$v_{ix} = 150\,m/s$	
$v_{iy} = 0\,m/s$	

We need to know how far ahead of the drop point it will land. The initial velocity is horizontal

$\vec{V}_i \longrightarrow$

$\Rightarrow \quad V_{ix} = 100\,m/s$

$V_{iy} = 0\,m/s$

Need $\quad x_f = \cancelto{0}{x_i} + V_{ix}\Delta t + \frac{1}{2}\cancelto{0}{a_x}\Delta t^2 \quad \Rightarrow \quad x_f = 150\,m/s\ \Delta t$

Now get Δt from vertical

$$y_f = y_i + V_{iy}\Delta t + \tfrac{1}{2}a_y\,\Delta t^2$$

$$\Rightarrow \quad 0\,m = 100\,m + \cancel{0\,m/s\ \Delta t} + \tfrac{1}{2}(-9.8\,m/s^2)\ \Delta t^2$$

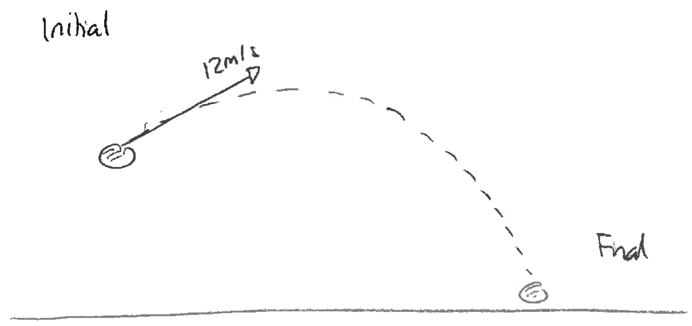
$$\Rightarrow \quad \frac{-200\,m}{-9.8\,m/s^2} = (\Delta t)^2 \Rightarrow \Delta t^2 = 20.4\,s^2 \Rightarrow \Delta t = \sqrt{20.4\,s^2} = 4.5\,s$$

So $\quad x_f = 150\,m/s \times 4.5\,s = 680\,m$

It must be dropped 680m short

Knight Ch4

4ed. Prob 15



$t_0 =$ 0s $\qquad t_1 =$

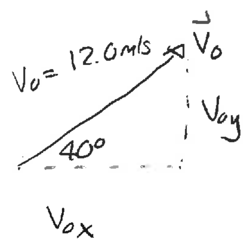
$X_0 =$ 0m $\qquad x_1 = ?$ $\qquad a_x = 0\,m/s^2$

$y_1 =$ 1.80m $\qquad y_1 = 0m$ $\qquad a_y = -9.8\,m/s^2$

$V_{0x} =$ 9.19m/s $\qquad V_{1x} =$

$V_{0y} =$ 7.71m/s $\qquad V_{1y} =$

Get components of initial velocity



$V_{0x} = V_0 \cos 40°$

$= 12.0\,m/s \cos 40° = 9.19\,m/s$

$V_{0y} = V_0 \sin 40°$

$= 12.0\,m/s \sin 40° = 7.71\,m/s$

Now we need x_1 and

$x_1 = x_0 + V_{0x} \Delta t + \frac{1}{2} a_x (\Delta t)^2$

$\Rightarrow x_1 = \cancel{0m} + 9.19\,m/s\, \Delta t + \cancel{\frac{1}{2}\, 0 (\Delta t)^2}$

$\Rightarrow$ $x_1 = 9.19\,m/s\,\Delta t.$

Then $y_1 = y_0 + v_{0y}\,\Delta t + \frac{1}{2} a_y (\Delta t)^2$ could give Δt

$$0m = 1.80m + 7.71m/s\,\Delta t + \frac{1}{2}(-9.8m/s^2)(\Delta t)^2$$

$$\Rightarrow \quad -4.9\,m/s^2 (\Delta t)^2 + 7.71m/s\,\Delta t + 1.80m = 0m$$

This is a quadratic of form

$$a(\Delta t)^2 + b\Delta t + c = 0 \quad \Rightarrow \quad \Delta t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$\Rightarrow \quad \Delta t = \frac{-7.71m/s \pm \sqrt{(7.71\,m/s)^2 - 4(-4.9m/s^2)\,1.80m}}{2 \times (-4.9m/s^2)}$$

$$= \frac{-7.71m/s \pm \sqrt{94.7\,m^2/s^2}}{-9.8m/s^2} = \frac{-7.71m/s \pm 9.73m/s}{-9.8m/s^2} = \begin{cases} -0.206s \\ \text{OR} \\ 1.78s \end{cases}$$

Only the positive could work $\Rightarrow$ $\Delta t = 1.78s$

Then

$$x_1 = 9.19\,m/s \times 1.78s$$

$$\boxed{x_1 = 16.4m}$$

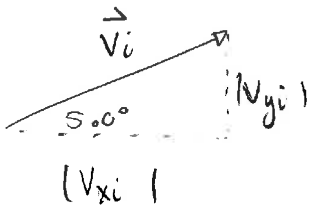
Knight Ch 4

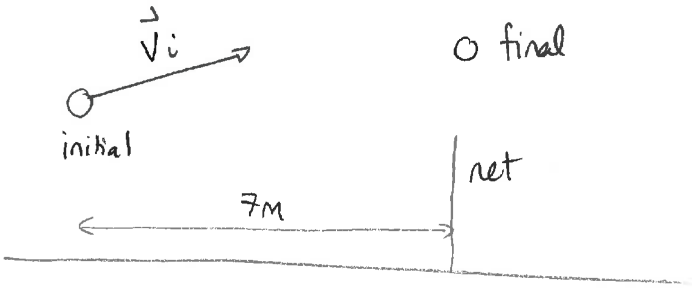
Prob 51

~~Prob 45~~ *

Find final height.

Need to resolve $\vec{v}_i$





$|V_{xi}| = |V_i| \cos 5°$

$= 20.0\,m/s \cos 5°$

$= 19.9\,m/s$

$|V_{yi}| = |V_i| \sin 5° = 20.0\,m/s \sin 5°$

$= 1.74\,m/s$

$t_i = 0$ $\quad$ $t_f = ?$

$x_i = 0m$ $\quad$ $y_i = 2.0m$ $\quad$ $x_f = 7.0m$ $\quad$ $y_f = ?$

$V_{xi} = 19.9\,m/s$ $\quad$ $V_{yi} = 1.74\,m/s$ $\quad$ $V_{xf} = ?$ $\quad$ $V_{yf} = ?$

$a_x = 0\,m/s^2$

$a_y = -9.8\,m/s^2$

Use vertical distance info:

$$y_f = y_i + V_{yi}\Delta t + \tfrac{1}{2} a_y \Delta t^2 \Rightarrow y_f = 2.0m + 1.7\,m/s\,\Delta t - \frac{9.8\,m/s^2}{2}\Delta t^2$$

We need Δt. Use horiz position info:

$$x_f = x_i + V_{xi}\Delta t + \tfrac{1}{2} a_x (\Delta t)^2 \Rightarrow 7.0m = 0.0m + 19.9\,m/s\,\Delta t$$

$$\Rightarrow \Delta t = \frac{7.0m}{19.9\,m/s} = 0.352s$$

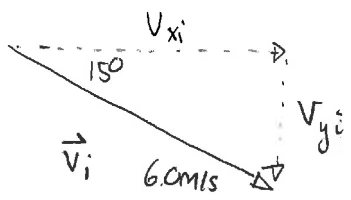
$$\Rightarrow y_f = 2.0m + 1.74\,m/s \times (0.352s) - 4.9\,m/s^2\,(0.352s)^2 = 2.01m$$

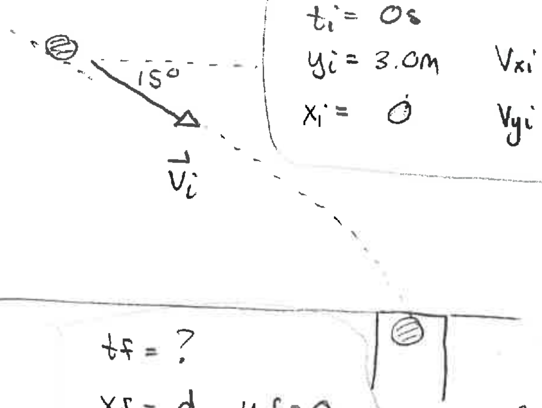
Clears net!

Knight Ch 4

~~Prob 49~~ Prob 56

We can determine initial velocity components via





$t_i = 0s$
$y_i = 3.0m$ $\quad V_{xi} = 5.8 m/s$
$x_i = 0$ $\quad V_{yi} = -1.6 m/s$

$t_f = ?$
$x_f = d$ $\quad y_f = 0$
$V_{xf} = ?$ $\quad V_{yf} = ?$

$a_x = 0$
$a_y = -9.8 m/s^2$

$$\frac{|V_{xi}|}{V_i} = \cos 15^\circ$$

$$\Rightarrow |V_{xi}| = V_i \cos 15^\circ$$

$$= 6.0 \, m/s \cos 15^\circ = 5.8 \quad \Rightarrow V_{xi} = 5.8 m/s$$

$$|V_{yi}| = V_i \sin 15^\circ \quad \Rightarrow |V_{yi}| = 6.0 m/s \sin 15^\circ = 1.6 m/s$$

$$\Rightarrow V_{yi} = -1.6 m/s$$

Then

$$x_f = x_i + V_{xi}\Delta t + \frac{1}{2} a_x \Delta t^2$$

$$\Rightarrow d = 5.8 m/s \, \Delta t$$

We just need Δt. To get this:

$$y_f = y_i + V_{yi}\Delta t + \frac{1}{2} a_y \Delta t^2 \Rightarrow 0 = 3.0 m/s + 1.6 m/s \, \Delta t - 4.9 \Delta t^2$$

$$\Rightarrow \Delta t = \frac{1.6 \pm \sqrt{1.6^2 + 4 \times 4.9 \times 3}}{-2 \times 4.9} = \frac{1.6 \pm 7.8}{-9.8} \Rightarrow \Delta t = 0.63$$

$=0 \qquad d = 3.7m$